Research of Influence Factors of Thermal Properties of Composites Reinforced by Nanopaper

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Abstract: The finite element software FLUENT is used to analyze the heating power and shapes of nanopaper on the thermal property of composites reinforced by nanopaper. The temperature cloudy maps of the polymer composites reinforced by pulse bending nanopaper shows the greater the heating power, the higher the maximum temperature along the section of z=0. At the same time, it can be observed that the high temperature region gradually expanded and gradually reached a stable process during the heating process. The curve of the ratio of heat loss to the total heat loss of Q_{total} by convection heat dissipation on the outer surface of polymer matrix composite reinforced by pulse bending and flat nanopaper shows that, with the increase of heating time, the increase of the external surface temperature makes the convection heat dissipation increase, so the proportion of the total heat consumption of Q_{total} is gradually increased. The research shows that the proportion of heat lost by convective heat dissipation in pulse bending and flat nanopaper is slightly different, and the proportion of heat lost by convective heat loss of pulse bending nanopaper is relatively larger than that of the total heat consumption.

1. Introduction

Carbon nanotubes (CNTs) have excellent properties, such as electrical, chemical, thermal and mechanical properties which are mainly due to their quasi-one-dimensional nature and extraordinary topology [1-4]. So CNTs have been used as reinforcement materials in multifunctional nanocomposites [5]. And the polymer composites reinforced by the nanopaper have excellent thermal conductivity

The finite element software FLUENT is used to analyze the heating power and shapes of nanopaper on the thermal property of composites reinforced by nanopaper.

2. Results and discussion

Figure 1 shows the temperature cloudy maps of the polymer composites reinforced by pulse bending nanopaper along the section z=0. The heating power of four temperature distributions in each time is 0.2W, 0.3W, 0.4W and 0.6W respectively.

The greater the heating power, the higher the maximum temperature in the z=0 section as shown in Figure 1. At the same time, it can be observed that with the heating process, the high temperature region gradually expanded and gradually reached a stable process.

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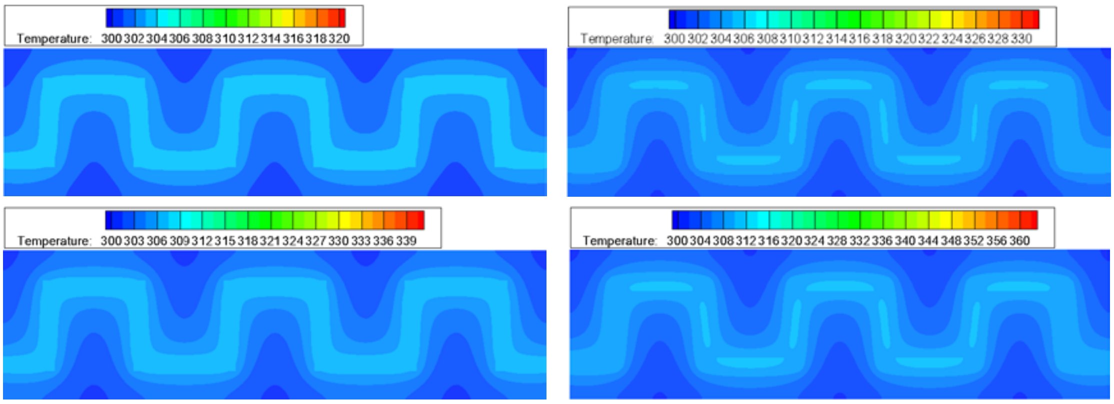
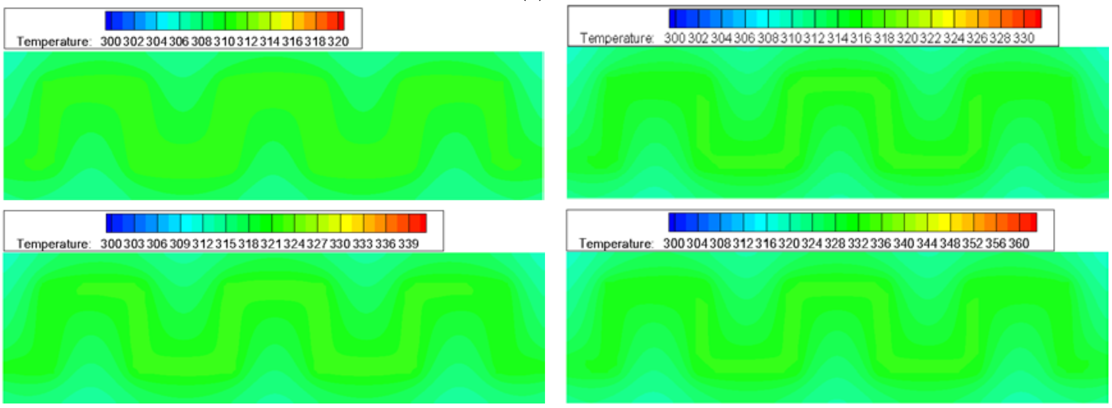


(a) 20s



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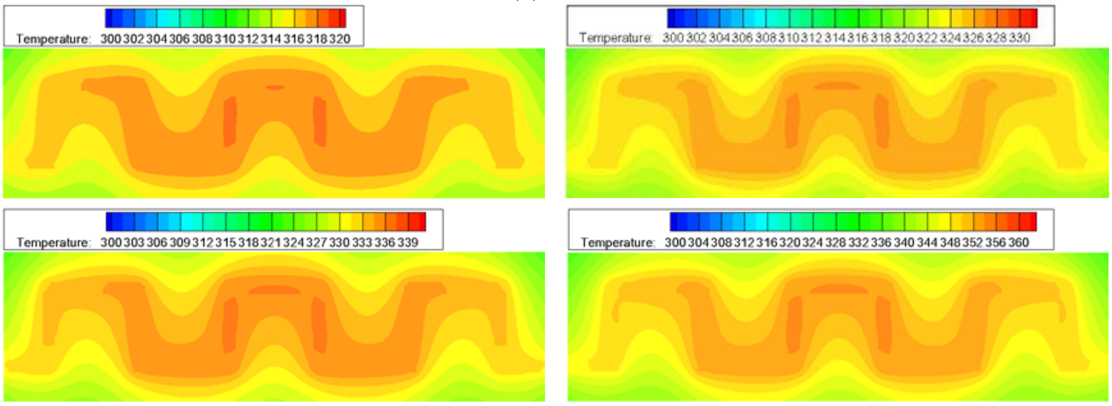
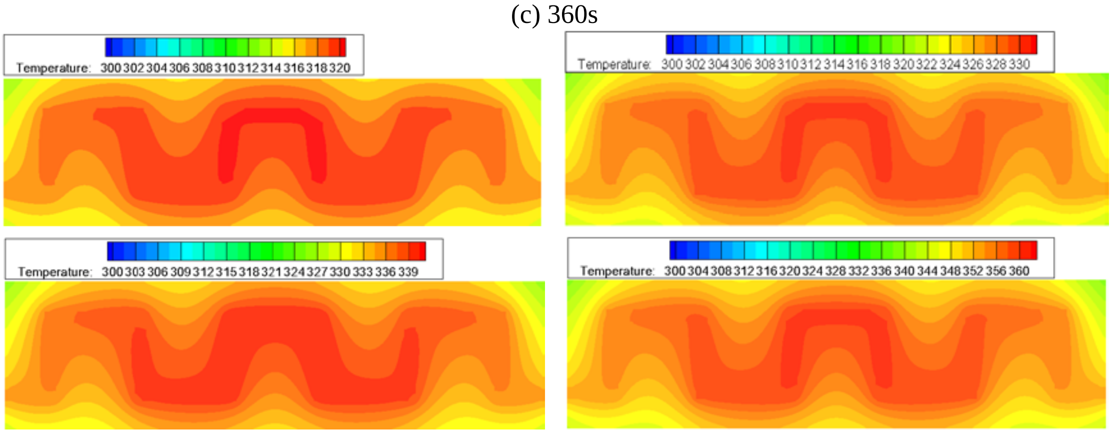
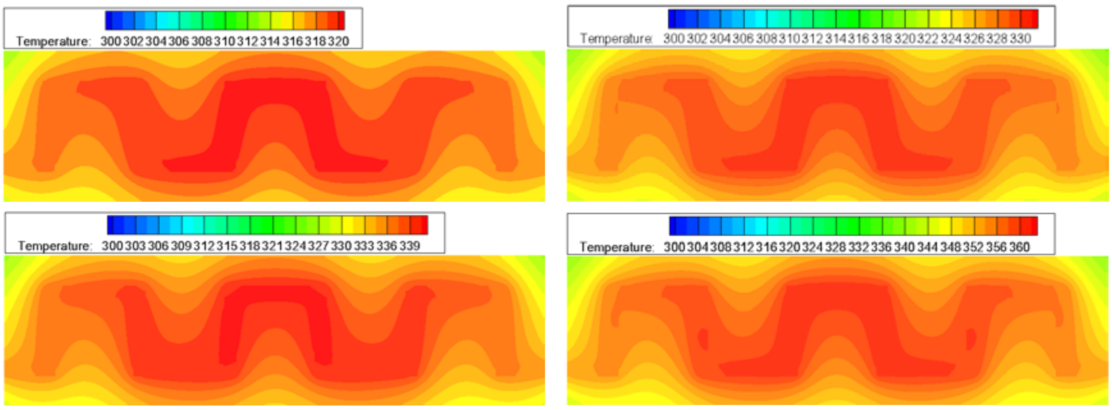


(c) 360s



(d) 720s



(e) 1128s

Fig. 1. Temperature distribution of nanocomposite with pulse shape heating sheet versus time under different heating power along the section z=0

Table 1 shows that the typical temperature of nanocomposites with pulse bending heating sheet versus time of the thickness of 1.2 mm along the section z=0

Table 1 Typical temperature of nanocomposites with pulse bending heating sheet versus time along the section z=0

Time/s	Tmax/K	Tmin/K	Tave/K
0	300	300	300
20	305.21	301.03	303.53
40	308.18	303.13	306.37
60	310.75	305.19	308.87
120	316.85	309.99	314.72
240	324.02	315.42	321.49
360	327.44	317.95	324.69
480	329.06	319.15	326.21
600	329.82	319.71	326.92
720	330.18	319.97	327.26
840	330.36	320.10	327.42
960	330.44	320.16	327.49
1080	330.47	320.19	327.53
1200	330.49	320.20	327.54
1320	330.50	320.20	327.55
1440	330.50	320.21	327.56

Figure 2 shows the curve of the ratio of heat loss to the total heat loss of Q_{total} by convection heat dissipation on the outer surface of polymer matrix composite reinforced by pulse bending and flat nanopaper. As shown in Figure 2, with the increase of heating time, the increase of the external surface temperature makes the convection heat dissipation increase, so the proportion of the total heat consumption of Q_{total} is gradually increased.

As shown in Figure 2, the research shows that the proportion of heat lost by convective heat dissipation in pulse bending and flat nanopaper heating sheet is slightly different, and that the proportion of heat lost by convective heat loss of pulse bending nanopaper is relatively larger than that of Q_{total}.

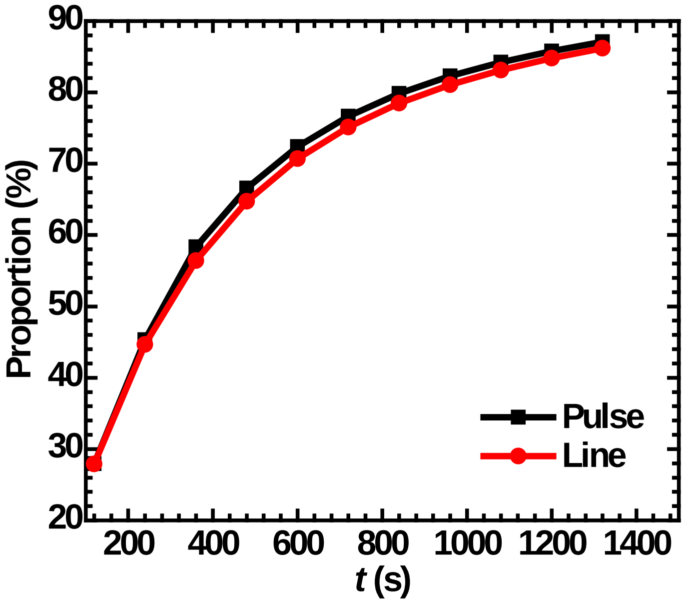


Fig. 2. Curve of proportion of heat loss through convection versus time

3. Summary

The finite element software FLUENT is used to analyze the heating power and shapes of nanopaper on the thermal property of composites reinforced by nanopaper.

The temperature cloudy maps of the polymer composites reinforced by pulse bending nanopaper shows the greater the heating power, the higher the maximum temperature along the section of z=0. At the same time, it can be observed that the high temperature region gradually expanded and gradually reached a stable process during the heating process.

The curve of the ratio of heat loss to the total heat loss of Q_{total} by convection heat dissipation on the outer surface of polymer matrix composite reinforced by pulse bending and flat nanopaper shows that, with the increase of heating time, the increase of the external surface temperature makes the convection heat dissipation increase, so the proportion of the total heat consumption of Q_{total} is gradually increased. The research shows that the proportion of heat lost by convective heat dissipation in pulse bending and flat heating sheet is slightly different, and that the proportion of heat lost by convective heat loss of pulse bending nanopaper is relatively larger than that of Q_{total}.

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